

M1. (a) % O = 21.6 % (1)

If % O not calculated only M2 available

$$\begin{array}{ccc} \text{C} & \frac{64.9}{12} & \text{H} & \frac{13.5}{1} & \text{O} & \frac{21.6}{16} & \text{(1)} \\ & = 5.41 & & = 13.5 & & = 1.35 & \end{array}$$

Ratio: 4 : 10 : 1 (\therefore C₄H₁₀O) (1)

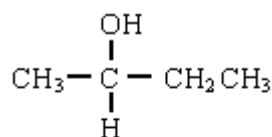
If arithmetic error in any result lose M3

If percentage composition calculation done zero

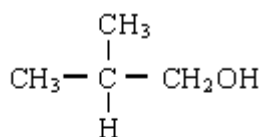
3

(b) (i) Type of alcohol: Tertiary (1)

Reason: No hydrogen atom on central carbon (1)



(1)



(1)

(ii) *Isomer 3*

Isomer 4

Penalise missing bonds / incorrect bonds once per paper

4

(c) (i) Aldehyde (1)

*Ignore named aldehydes or their structures,
penalise wrong named compound*

(ii) CH₃CH₂CH₂CH₂OH + [O] → CH₃CH₂CH₂CHO + H₂O (1)
Balanced (1)

C₄H₁₀O is OK as a reactant

[O] can be over arrow

C₃H₇CHO not accepted for product, but C₂H₅CH₂CHO is OK

If use C₃ or C₅ compounds no marks in (ii) C.E of wrong

alcohol

- (iii) Name Butanoic acid (1)
 Structure: CH₃CH₂CH₂COOH (1)
 mark conseq. or as stated

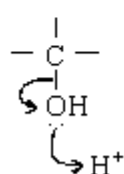
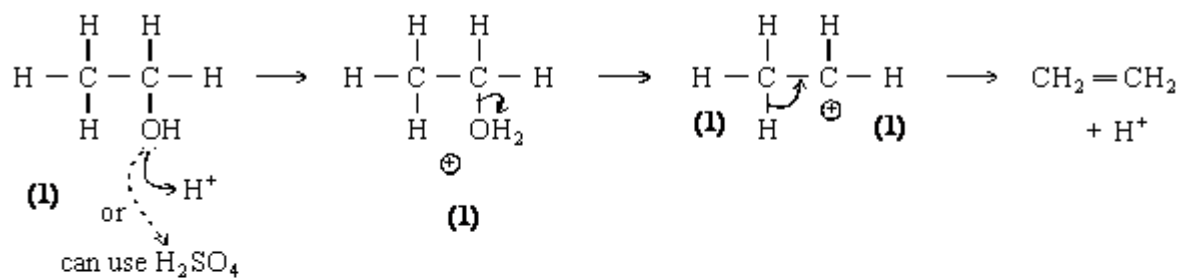
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- (d) Advantage: Fast reaction OR pure product OR continuous process
 OR cheap on manpower OR high yield, 100% alcohol (1)
 Disadvantage: High technology OR ethene from non renewable source
 OR expensive equipment not just costly (1)

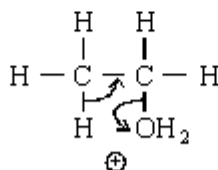
Not answers based on fermentation

2

- (e)



scores M1 only



scores M2 & M4
 but not carbocation mark, M3.

4

[18]

- M2.** Condition = two from yeast (anywhere in question)
 Air excluded or sterile / clean (2)

Ignore references to pressure / temperature / aqueous / dark
 / high alcohol conc

Temperature too low inactivates / deactivates enzymes **or** reaction too slow **(1)**

Temperature too high destroys **or denatures** yeast / enzymes **(1)**

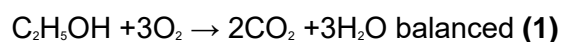
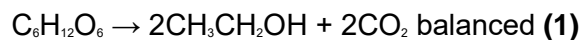
Not kills enzymes; not deactivates here

Advantage 1 = sugar / glucose / carbohydrate is renewable resource / source **(1)**

Advantage 2 = production uses low level technology / cheap equipment **(1)**

Ignore references to energy

Do not allow contra-arguments about ethene



Allow C₂H₆O but penalise C₂H₅HO once

[8]

M3.A

[1]